FORMWORK SYSTEMS

TECHNICAL FIELD

The present invention relates to formwork systems.

BACKGROUND ART

In my International Patent No.PCT/AU98/01059 I have described a formwork system based on a combination of modules which facilitates the forming of solid concrete walls.

Whilst the system described has been proven as a viable and economic system for forming walls and columns the acceptance of same is, I believe, dependant upon labour saving efficiencies.

It is an object of the present invention to provide improvements to the technology described in my above-mentioned patent application.

Further objects and advantages of the present invention will become apparent from the ensuing description which is given by way of example.

DISCLOSURE OF INVENTION

According to the present invention there is provided a method of construction for concrete beams or walls comprising the steps of;

(a) setting rows of a plurality of boxing modules in an end to end relationship to create a formwork,

(b) fastening abutting ends of the modules, and

(c) spacing the formwork by a plurality of spacers which span between the module panels and are fixed by bolts, or push-in ties,

(d) bracing and straightening the formwork as required,

(e) setting reinforcing between the formwork as required, and

(f) pouring concrete into the formwork.

The spacers can be hollow tubular members or push-in ties.

The boxing modules can be joined utilising slots in side and end walls of the modules.

The quick release clamping devices are used to join the side and end walls of the modules.

The quick release clamping device can be a wedge.

The quick release clamping device can be a strap which joins respective ends of the modules and sets the spacings between the modules.

The individual modules can comprise a rectilinear front face, a peripheral border wall extending from the front face, two spaced pairs of bolt sockets in major surfaces of the modules and a plurality of opposed slots in the peripheral border walls of the modules.

According to a further aspect of the present invention, there is provided a method of creating a formwork for a horizontal column from a plurality of modules, supporting the formwork from a surface below and integrating the columns with a floor slab.

According to a further aspect of the present invention, there is provided a formwork comprising a plurality of joined boxing modules in an end to end relationship where each boxing module has front and rear faces and a continuous peripheral flange about the rear face said flanges having openings thereon so that the boxing modules can be united via the flanges using quick release clamping devices.

The joined boxing modules can be made parallel by a plurality of spacers spanning between the modules.

The quick release clamping devices can be wedges.

The quick release clamping devices can be straps.

The formwork can be braced and stiffened by elongate braces.

The braces can be vertical, horizontal or angular.

The boxing modules can be moulded in plastics.

The boxing module may be rota-moulded.

Some of the module panels may be joined and others may not be joined.

The inner walls of the module panels may be used to create designs or patterns in a formed wall.

The formworks may be reinforced by elongate straps or trusses.

The modules may be joined in a staggered formation.

The module may be provided with integral or external stiffening

members.

The modules may include vertical and horizontal reinforcing members which extend from the ends and top and bottom surfaces thereof.

BRIEF DESCRIPTION OF DRAWINGS

Aspects of the present invention will now be described with reference to the accompanying drawings in which;

Figure 1 is a perspective drawing of a formwork module according to one aspect of the present invention, and

Figure 2a is a perspective drawing showing a spacer and lug combination for the modules of the present invention, and

Figures 3 and 4 are drawings of spacer systems according to aspects of the present invention, and

Figure 5 is a sectional drawing of a clamping arrangement for joining adjacent walls of modules of the present invention, and

Figure 6 is a further form of spacer/joiner according to the present invention, and

Figure 7 is a sectional drawing of a boxing arrangement according to the present invention.

Figure 8 is a side view of a compound panel according to the present invention comprising a plurality of panels joined by beams, and

Figure 9 is a perspective view of modules according to the present invention joined by H-shaped brackets, and

Figures 10 and 10a show lengths of materials joined brackets and incorporating moulding strips between the layers of modules, and

Figure 11 is a side view at yet a further alternative form of module bracket according to the present invention, and

Figure 12 and 12a show a side wedge for joining adjacent modules, and

Figures 13a to 13f show various forms of joints for joining panels according to aspects of the present invention, and

Figure 14 shows a further form of module according to the present invention, and

Figure 15 is a plan view of a further form of formwork according to the present invention, and

Figures 16 and 17 are cross-sectional views of methodology for forming a horizontal beams according to the present invention, and

Figure 18 is a plan view of a bracing member according to the present invention, and

Figures 19a and 19b are illustrations of bracing members according to the present invention, and

Figure 20 is a side view of a scaffold according to the present invention, and

Figure 21 is a side view of assembled modules of the present invention stiffened by larger panels, and

Figures 22a, 22b, 23a, 23b, and 24a, to 24c are illustrations of quick release connection members according to further aspects of the present invention, and

Figure 25 is an end view of a U-bolt for connecting modules of the present invention, and

Figures 26, 26b and 27 are details of formwork corners according to the present invention, and

Figure 28 is a side view of adjustable spacers according to aspects of the present invention, and

Figure 29 is a plan view of assembled and staggered modules, and

Figure 30 is a side view of a further form of adjustable spacer according to the present invention, and

Figure 31 is a perspective view of a strapping system for the modules of the present invention, and

Figure 32 is an illustration showing the formwork used to construct a curved wall, and

Figures 33a to 33c are illustrations of further methods used to join the edges of panel modules according to the present invention, and

Figure 34 is a front view of a plurality of modules held together,

as reinforced by vertical straps, and

Figures 35a to 35d are side views of stiffening members for a plurality of panels, and

Figures 36a to 36c are side, perspective and side views of stiffening/bracing members according to the present invention, and

Figure 37 is a front view of a plurality of modules joined by horizontal and vertical beams, and

Figure 38 is a front view of a blank out for windows/doors or the like according to the present invention, and

Figure 39 is a plan view of modules and stiffening members according to a further aspect of the present invention, and

Figure 40 is a side view of a concrete elevator apparatus, and

Figures 41a, 41b, 42a and 42b are front views of larger modules reinforced by stiffening members, and

Figures 43a to 43c are sectional drawings of rota-moulded modules according to the present invention, and

Figure 44 is a front perspective view of a panel according to another aspect of the present invention, and

Figures 45 and 45a are plan views of a still further form of a panel according to the present invention, and

Figure 46 is a side view of a plurality of panels of different sizes showing the creation of openings for door and window block outs, and

Figure 47 is a perspective view of a panel showing a number of options for strengthening the panel, and

Figure 47a is a sectional drawing showing the cross-section of the panel in the position indicated, and

Figure 48 shows how a floor can be poured over the top edge of a wall formed in accordance with the present invention.

With respect to figure 1 of the drawings, a module according to the present invention may comprise an elongate rectilinear body 1 strengthened by peripheral side walls 2 which extend from one major surface of the body.

The side walls 2 can be provided with opposed pairs of open slots 3 which align with two sets of bolt sockets 4 which also extend from one major surface of the body 1.

Figure 2 of the drawings illustrates one possible form of spacer according to the present invention.

The spacer 5 is an elongate tube having ends 6 which receive shutter bolts 7.

The spacer 5 can be provided with rod supports 5a which provide for vertical and horizontal support for reinforcing bars.

The spacer 5 can be used in conjunction with H-shaped lugs 14 (see figure 6) for modules which have wasted corner or edge sections. The H-shaped lugs 14 pass through slots 16 in the flanges 2 of adjacent modules and the ends 14a of each of the limbs of the lugs are a snap-fit on ramps 1a on the exterior walls of the module. A pre-assembly of the spacer 5, bolts 7 and lugs 14 can be used to join adjacent modules as is illustrated by figure 2.

In figure 3 another possible form of spacer is illustrated in the form of an elongate bar 8 which extends beyond the body of a module. The extending ends 8a of the bar are provided with slots 8b adapted to receive wedges 9.

In figure 4 chains or chords 10 having short arms 11 are used to brace two opposed modules and locate in slots 3 or in sockets 4.

In figure 5 abutting walls 2 of the modules are clamped by opposed slotted keys 12.

In figure 6 of the drawings an elongate bar 13 having H-shaped lugs 14 can be used to join walls 2 of a module provided with complementary slots or indents. The ends of the bar 13a may be provided with a saw-tooth or the like stepped portions 13b which can be locked together or released using a sleeve (not shown).

Figure 7 of the drawings illustrates an example of use of the modules of the present invention for forming a concrete column in conjunction with a floor slab.

A prop and plates 15 support opposed modules joined by

spacers 5.

An integrated floor slab (not shown) can be poured over boxing 16 which provides edge support for the boxing.

With respect to figure 8 of the drawings a plurality of modules 20 can be joined using vertical or horizontal beams 21.

Attachments between the beams and modules can "skip" one or more modules to reduce the number of ties used.

In figure 9 of the drawings H-shaped brackets 22 having module engaging lugs 23 join abutting ends of the modules. The modules are provided with slots 24 in peripheral walls 25.

Figures 10 and 10a of the drawings show modules 26 joined by cross braces 27.

The braces 27 can be of the type previously described or a single strap having slot engaging lug 28.

Strips of timber 29 or the like can be placed on the horizontal flanges 30 of the modules so that an edge portion 31 extends beyond the internal edge of the module. The edge portion can be used to create horizontal flutes in the subsequently poured wall.

With respect to figure 11 of the drawings opposed modules 26 can be joined by a sacrifice wedge bar 32 having a toe-piece 33 which engages in a slot 34 adjacent a backing plate 35 of a tie 36.

The tie 36 can confirm a further slot (not shown) for a wedge 37 or can be threaded for a bolt 38.

When the modules are stripped any extending portion of the tie can be removed by cutting or using an input tool.

With respect to figures 12 and 12a of the drawings joining wedges of he invention typically comprise a limb 39 and a wedge bar 40 which is slotted at 41.

The lower edge 42 of each bar 40 is flat and the upper edge 43 thereof is arcuate.

With respect to figures 13a-13f of the drawings, the modules may be constructed or joined using tongue and groove jointing as shown in

figures 13a, 13d and 13e, shiplap joints as shown in figure 13b, or overlapping joints as illustrated by figures 13c and 13f.

Figures 14 and 15 of the drawings show inner panels 50 having a plurality of apertures 51 therein with the panels being joined by reinforcing outer panels 52 secured by bolted spacers 53. The inner panels 50 can be plain or patterned for decorative enhancements to a wall. Screws 46 can be used to join the outer panels 52 to the inner panels 50.

Figures 16 and 17 show methods of beam construction.

In figure 16, an I-beam 54 can be constructed using web and flange formers 55, 56 secured by threaded through bolts 57. Nuts 58 are used to space the formers. The formers can be constructed by using a combination of modules and boards and elongate timber cornices as indicated.

In figure 17, a rectangular beam 59 is formed about modules and edge formers 60. The beam 59 may have an internally positioned tube or pipe 61 with threaded through bolts 62 setting the spacings between elements of the formwork.

Figure 18 shows an elongate bracing bar 63 having spaced lugs 64 which can be used to brace and secure panels.

Figures 19 and 19a show a bracing props 65 when the central portion 66 thereof is adjustable for length in any suitable manner.

Figure 20 shows a scaffold having an upright 67 and an extending L-shaped platform support 68. A brace 69 extends between the upright 67 and the support 68.

Figure 21 shows modules 69 with stiffening panels 70 on the outer faces of the modules for the purpose of stiffening the grouped modules. The panels are bolted to the modules via apertures 69a and the outer surfaces of the panels 70 overlap the peripheral edges of each module to provide rigidity to the structure.

Figures 22 to 24 show alternate forms of flange fasteners.

In Figure 22 an I-section member 71 having extending flanges 72 is used to grip the flanges 73 of adjacent modules

Figure 23 illustrates a similar I-section member 74 which in

combination with wedges 75 can be used to fasten the flanges of adjacent panels.

Figures 24a and 24b shows a twist lock fastener comprising a circular grip 76 and a web 77 which supports circular flanges 78 and 79.

Figure 24c shows a cam lock mechanism for locking together the flanges of modules of the present invention. The lock mechanism can comprise a tee-shaped key 17 mounted on a plate 18 and a cam arm 19 having two arcuate forks 19a. The key is inserted into aligned slots in the flanges of a module and the forks engaged with the top bar of the key and the cam arm 19 rotated to lock the respective flanges together.

The flanges 79 are inclined and when the fastener is fitted onto the flanges 80 of the modules and rotated, it holds the panels together.

Figure 25 shows a method of spacing panels using a U-shaped bolt 81. The bolt can be secured by nuts 82.

With respect to figure 26a of the drawings, a formwork for a corner utilising modules/modified modules 83 and a rectangular post 84. Ties 85 are used to space and join the modules in the manner indicated.

In figure 26b, modules/modified modules 86 are used to form a corner formwork in conjunction with an internal post 87 in the manner illustrated. Ties 88 can be used to join the modules and strengthen the formwork at the corners by intersecting and overlapping same.

In figure 27, conventional timber panelling 89 is joined by ties 90 is used to form a corner formwork.

Figure 28 illustrates another form of tie for joining modules 92 and in this arrangement, a central threaded collar is mounted on threaded rods 94 and is used to set the spacing between the modules.

Figure 29 indicates how modules 95 can be assembled in a staggered formation and spaced by ties 96.

Figure 30 illustrates a still further form of adjustable tie according to the present invention. In this case, the tie comprises a central rod 97 attached to threaded collars and fixture bolts 99 which engage with module walls 100.

Figure 31 of the drawings illustrates a method of strapping and spacing modules 101 using side straps 102 and rectangular straps 103. The straps provide rigidity to the formwork and reduce the number of holes in a finished wall. The straps can be used in any place and can be connected to other straps. The strap 103 can be replaced by a threaded rod or bolt and may be of varying cross-sections.

An assembled formwork may be provided with vertical and horizontal reinforcement bars VT and VH respectively. The bars may extend from the ends or top and bottom surfaces of the formwork.

Figure 32 illustrates a possible formwork detail for forming curved walls using panels or modules 104, external and internal wedges 105, internal flexible liners 106 and ties 107. Packers 108 can be used to take up edge space between the liners 106 and the panels 104.

Figure 33 shows various means for strengthening the joints between modules 109 using angles 110, tie pieces 111 and box section 112.

Figure 34 shows a plurality of modules 113 joined by stiffeners 114 to form a larger panel.

Figure 35a illustrates the arrangement of figure 34 in end profile, and figures various forms of truss arrangement for reinforcing a larger panel incorporating a number of modules.

The stiffening members of figures 35c or 35d can be provided with improved rigidity by the provision of a length adjusting feature 47 positioned on strategic limbs 48 of the members.

Figures 36a to 36c illustrate a stiffening member 115 with lugs 116 for engaging with modules (not shown) and a ground brace 117. The stiffening members enable a panel formed from a number of modules to be moved as one.

Figure 37 illustrates how the stiffening members 115 can be used to stiffen a plurality of modules 118 in horizontal and vertical planes.

Figure 38 illustrates how the stiffening members 115 can be used to stiffen a block-out member 118 in a horizontal, vertical and diagonal planes.

Figure 39 illustrates how an I-section beam 119 can be used to stiffen formwork boards 120 along vertical seam 121. Similar techniques and procedures can be used to stiffen block-out which create cavities in the outer surfaces of a finished wall.

Figure 40 of the drawings illustrates a possible form of concrete elevator comprising a conveyor 122, scoops 123 and a stand 123. The conveyor may be motorised.

Figures 41a, 41b, 42a and 42b illustrate how larger modules or forming panels 124 can be strengthened using angles 125 and inserts 126.

Larger modules or panels may be manufactured using rota-moulding techniques.

Several shapes are possible as illustrated in figures 43a to 43c. Because of the nature of the rota-moulding process, two panels can be manufactured at once in a split casing mould and cut soon after release from the moulds on axis "Y". Strengthening ribs 127 may be provided in the moulding.

Figure 43c shows a form of hollow module which can be foam filled.

With respect to figure 44 of the drawings a rectilinear rotamoulded panel is formed with peripheral strengthening flanges 130 and intersecting reinforcing ribs 131 and a plurality of conjoined ribs 132. The flanges 130 and ribs 131 are apertured as indicated to facilitate the joining of adjacent panels. Half apertures 133 may be provided in the flanges 130 which when matched will form a bolting aperture.

The rear surface of the panel (not shown) may be plain or embossed to create aesthetic appeal.

Figures 45 and 45a of the drawings show the panels in plan with figure 45 having a plan view of the panel of figure 44.

In figure 45a, the plan view of the panel varies slightly in that vertical ribs 134 are extended for added strength.

The panels may be foam filled for additional strength and durability.

In all cases, the ribs 130, 131 and 134 can be strengthened by the use of channel sections 135 either attached to individual or adjoining panels.

For additional strength, the ribs 132 may be "kissed off" with the rear wall during manufacture in accordance with known rotamoulding practices.

Figure 46 shows how a number of different sized panels 136, 137, 138 and 139 can be joined to facilitate block outs where windows and doors are to be situated.

The panel sizes may vary to suit standard building panel and door sizes.

The panels may also be used on a horizontal plane between boxed out beams for forming concrete floors in the manner previously described.

With respect to figures 47 and 47a, the panel illustrated shows a plurality of possible ways of strengthening the panel by providing hollow openings 139 of varying shapes which stiffen the panel.

With respect to figure 48 the top edges 140 of formed walls may be provided with crosswire channels 141 into which T-section beams 142 can be dropped to form a base for pouring a floor 143 over the beams.

It is to be appreciated that the rotamoulding process allows the formation of curved as well as straight panels.

The rotamoulding process also facilitates the formation of complementary corner sections.

I consider the substantive advantages of the present invention to be;

(a) the modules can be placed around existing standing steel,

(b) additional steel can be added as part of the boxing operation,

(c) full length steel can be used to reduce joins and overlaps,

(d) push-on ties and quick release attachments provide a significant labour saving advantage,

(e) the use of full length steel provides rigidity for the modules,

helping alignment and integrity of the structure,

(f) most of the elements used to form a wall or column can be reused,

(g) assembly of the modules can be off-site or insitu,

(h) conventional propping system can be used as required,

(i) horizontal columns can be readily integrated with a floor slab,

(j) the columns can be pre formed on the ground,

(k) simultaneous assembly steel placement and pouring of concrete is facilitated.

(l) Stop ends and templates of any shape, for windows, doors etc can be placed between the modules and secured with respect to the module walls and/or ties.

(m) The methodology can be used to erect wall sections between tilt panels.

Aspects of the present invention have been described by way of example only and it will be appreciated that modifications and additions thereto may be made without departing from the scope thereof, as defined in the appended claims.